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EFFICACY OF 2% ZINC PHOSPHIDE APPLIED WITH AND WITHOUT A PREBAIT FOR CONTROL OF THE COLUMBIAN GROUND SQUIRREL.

prepared by:

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Final Report to Bell Laboratories, Inc.

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FINAL REPORT TO BELL LABORATORIES

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INTRODUCTION

The columbian ground squirrel, *Spermophilus columbianus*, is one of the most economically harmful rodents in Montana. In 1973 an estimated 0.8 million dollars in damage to agricultural crops was attributed to this species (Seyler 1973). Control efforts using currently registered rodenticides have been ineffective and with the potential cancellations of strychnine and 1080 by the Environmental Protection Agency, Montana landowners will have few, if any, efficacious rodenticides available to control this pest.

Zinc phosphide has been used for ground squirrel control since the 1940's but has not been tested sufficiently against the columbian ground squirrel. Label directions usually require prebaiting with oats 2 to 3 days prior to application in order to achieve better acceptance of the bait. This feature makes zinc phosphide objectionable to many rodenticide applicators because the labor involved in application is essentially doubled.

In order to investigate the potential control of the columbian ground squirrel with zinc phosphide, the following study was conducted with these two objectives:

1. Investigate the field efficacy of 2% zinc phosphide against the columbian ground squirrel.

2. Compare the field efficacy of 2% zinc phosphide applied with and without a prebait.

METHODS

In May 1980, four alfalfa fields infested with columbian ground squirrels were selected as study sites near Boulder in southwestern Montana (Table 1). Criteria influencing field selection included the following:

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Table 1. Descriptions of study fields and treatment dates.

Field Identification	Field Size (acres)	No. of Plots	Treatment	Date of Prebait	Date of Treatment
Phelan	6	2	No Prebait	N.A.	May 4
Schavan	3.5	2	No Prebait	N.A.	April 27
Larsen A	9	4	Prebait	Apr.27 and 29	May 4
Larsen B	8	2	Control	N.A.	N.A.

1) Fields contained populations of columbian ground squirrels that were near the maximum population density for the area.
2) Fields had similar compositions of vegetation consisting of alfalfa and grass.
3) Ground squirrel populations were in areas that could be observed through binoculars.

Plots measuring 100 X 100 feet were established in the study fields in areas of maximum squirrel density and boundaries delineated with flagged markers. Pre and post treatment visual count and active burrow count were conducted within these plots to determine the efficacy of the zinc phosphide treatments.

Visual counts consisted of 3 observations taken with binoculars at 5 minute intervals on each of 3 consecutive days. All squirrels within the plots were counted. Counts were conducted during the morning activity period of the squirrels (7:30 - 9:00 a.m. M.S.T.) and at the same time for each plot each day. Pre-treatment visual census were conducted 3 days immediately prior to treatments and the post treatment census were conducted 48 hours after treatments.

An activity index (AI) was computed for each plot from the results of the visual counts by determining the averages of the daily maximum count. Efficacies of the treatments were then determined by the following method:

$$\text{Percent Control} = \frac{\text{Pretreatment AI} - \text{Post treatment AI}}{\text{Pretreatment AI}} \times 100$$

Effects on the numbers of active burrows were also determined for each plot. All burrows within a plot were manually closed with soil and those that had been reopened were counted 48 hours later, just prior to treatments. This procedure was repeated 48 hours after baiting and percent reductions in the numbers of active burrows were computed as follows:

$$\text{Percent Reduction} = \frac{\text{Pretreatment AB} - \text{Post treatment AB}}{\text{Pretreatment AB}} \times 100$$

Plots were treated with 2% zinc phosphide treated pellets (Bell Laboratories' ZP Rodent Bait AG) applied with a dipper calibrated to contain 6.24 grams (0.22 ounces) of bait. One dipper of bait was scattered near the entrance to each burrow and a 200 foot buffer zone was also treated in the same manner around each plot. Two control plots received no treatments.

Plots receiving a prebait were treated twice, 7 and 5 days prior to zinc phosphide baiting, with untreated rolled oats applied to each burrow in a manner identical to that described above.

Means for pre and post treatment activity indeces were compared statistically using Student's t-test as were reductions in squirrel activity and active burrows in plots receiving prebait with those receiving no prebait.

Samples of the zinc phosphide treated pellets were analyzed for active ingredient by the Laboratory Bureau, Environmental Management Division, Montana Department of Agriculture using standard laboratory methods.

RESULTS

Of the four analyses of the treated bait, two were found to contain 2.2% and two had 2.3% zinc phosphide, both levels within laboratory criteria.

Percent reductions in ground squirrel activity due to the zinc phosphide treatments are shown in Table 2. Where no prebait was applied, reductions ranged from 4.3 to 82.3%. In prebaited plots, reductions ranged from 37.8 to 66.7%. One control plot had a 30.2% reduction in activity; however, squirrel activity in the second control plot increased by 74.1%.

Reductions in numbers of active burrows are presented in Table 3. Where no prebait was applied, reductions ranged from 23.1 to 48.0% and where a prebait was applied, reductions ranged from 30.1 to 76.5%. Commensurate with visual observations, one control plot had an 18.5% reduction in active burrows and the other underwent a 40.8% increase.

Table 2. Reductions in columbian ground squirrel activity due to zinc phosphide treatments under prebait and no prebait conditions.

Field Identification	Plot No.	Treatment	PRE-TREATMENT No. of Counts	PRE-TREATMENT Mean Squirrels Per Count	PRE-TREATMENT Range	POST TREATMENT No. of Counts	POST TREATMENT Mean Squirrels Per Count	POST TREATMENT Range	Percent Reduction
Larsen A	1	Prebait	3	3.7	2 - 5	3	2.3	1 - 4	37.8
Larsen A	2	Prebait	3	3.7	2 - 5	3	1.3	1 - 2	64.9
Larsen A	3	Prebait	3	3.7	3 - 4	3	1.3	1 - 2	64.9 **
Larsen A	4	Prebait	3	3.0	2 - 4	3	1.0	0 - 2	66.7
Phelan	1	No prebait	3	11.3	10 - 13	3	2.0	2 - 2	82.3 **
Phelan	2	No prebait	3	8.0	6 - 10	3	2.7	2 - 3	66.3 **
Schavan	1	No prebait	3	4.7	4 - 5	2	4.5	3 - 6	4.3
Schavan	2	No prebait	3	2.3	1 - 5	2	1.5	1 - 2	34.8
Larsen B	1	Control	3	4.3	4 - 5	3	3.0	3 - 3	30.2
Larsen B	2	Control	3	2.7	2 - 3	3	4.7	3 - 6	74.1 *

* Increase in activity
** Significantly different means ($P < 0.05$)

Table 3. Reductions in numbers of active burrows due to treatments with 2% zinc phosphide under prebait and no prebait conditions.

Field Identification	Plot No.	Treatment	NO. OF ACTIVE BURROWS Pretreatment	Post Treatment	Percent Reduction
Larsen A	1	Prebait	29	17	41.4
Larsen A	2	Prebait	47	15	68.1
Larsen A	3	Prebait	26	18	30.1
Larsen A	4	Prebait	17	4	76.5
Phelan	1	No prebait	25	13	48.0
Phelan	2	No prebait	18	12	33.3
Schavan	1	No prebait	29	20	31.0
Schavan	2	No prebait	13	10	23.1
Larsen B	1	Control	27	22	18.5
Larsen B	2	Control	15	21	40.0 *

* Increase in active burrows

When results from plots with a similar treatment were averaged (Table 4), squirred activity and active burrow counts for the control plots increased by only 8.5 and 2.4%, recpectively, during the study period. Reductions in squirrel activity were 60.6% for plots not receiving a prebait and 57.1% for prebaited plots, a non significant difference statistically ($P > 0.05$). Overall reductions in active burrows were 35.3% for plots with no prebait and 54.6% for those receiving a prebait, a statistically significant difference ($P < 0.05$).

After treatments, observations were made concerning non target mortalities and none were noted. Also, only three ground squirrels were observed dead above ground.

DISCUSSION

The degree of control achieved by 2% zinc phosphide treated pellets was not economically efficacious in this test irregardless of whether a prebait was applied. Reductions in squirrel activity were; however, somewhat higher than the 41.5% reported by Montana Department of Livestock personnel for 0.8% zinc phosphide on rolled oats applied without a prebait (Albert and Record 1979). Reasons for the low efficacy observed in this study were not readily apparent. Post treatment observations did show that much of the treated pellets were not consumed even though the rolled oats applied as prebait had been readily consumed.

The additional amount of control achieved by applying a prebait was evident as measured by burrow counts. Numbers of active burrows were reduced by an additional 19% when untreated rolled oats were applied as a prebait. This difference in control was not apparent from the results from activity indeces even though control appeared to be more consistent in plots receiving a prebait.

Table 4. Mean reductions in squirrel activity and numbers of active burrows due to treatments with 2% zinc phosphide under prebait and no prebait conditions.

	Treatment	PRE-TREATMENT		POST TREATMENT		Percent Reduction
		No. Counts	Mean No. Squirrels Per Count	No. Counts	Mean No. Squirrels Per Count	
SQUIRREL ACTIVITY	Prebait	12	3.5	12	1.5	57.1
	No Prebait	12	6.6	10	2.6	60.6
	Control	6	3.5	6	3.8	8.6 *
ACTIVE BURROWS		Total Burrows		Total Burrows		
	Prebait	119		54		54.6
	No Prebait	85		55		35.3
	Control	42		43		2.4 *

* Increase in activity or active burrows.

References:

Albert, S.W. and C.R. Record. 1979. Efficacy and cost of four rodenticides for columbian ground squirrel damage control in Western Montana. Montana Department of Livestock Report. 17 pp.

Seyler, K. 1973. Rodent damage and control survey of 50 Montana counties. Montana Department of Livestock Report. 3 pp.

APPENDIX: Field data for visual observations

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen A

Plot Number 1

Treatment 2% Zinc phosphide, prebait with rolled oats

Pretreatment date April 27 and 29, 1980

Treatment date May 4, 1980

Pre-treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	1	2	2
4-25-80	5	3	5
4-26-80	3	4	2

Pre-treatment Activity Index 3.7

Post treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	1	1	0
5-9-80	2	2	2
5-11-80	2	2	4

Post treatment Activity Index 2.3

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen A

Plot Number 2

Treatment 2% Zinc phosphide, prebait with rolled oats

Pretreatment date April 27 and 29, 1980

Treatment date May 4, 1980

Pre-treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	1	2	2
4-25-80	5	4	4
4-26-80	3	3	4

Pre-treatment Activity Index 3.7

Post treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	1	1	1
5-9-80	1	1	2
5-11-80	0	0	1

Post treatment Activity Index 1.3

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen A

Plot Number 3

Treatment 2% Zinc phosphide, prebait with rolled oats

Pretreatment date April 27 and 29, 1980

Treatment date May 4, 1980

Pre-treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	3	1	4
4-25-80	4	4	4
4-26-80	1	1	3

Pre-treatment Activity Index 3.7

Post treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	0	0	1
5-9-80	1	1	1
5-11-80	2	1	1

Post treatment Activity Index 1.3

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen A

Plot Number 4

Treatment 2% Zinc phosphide, prebait with rolled oats

Pretreatment date April 27 and 29, 1980

Treatment date May 4, 1980

Pre-treatment Visual Observations:	Date	Obs. 1	Obs. 2	Obs. 3
	4-24-80	1	3	3
	4-25-80	1	2	2
	4-26-80	3	4	4

Pre-treatment Activity Index 3.0

Post treatment Visual Observations:	Date	Obs. 1	Obs. 2	Obs. 3
	5-8-80	0	0	0
	5-9-80	0	1	0
	5-11-80	2	2	2

Post treatment Activity Index 1.0

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen B

Plot Number 1

Treatment Control plot, no treatment

Pretreatment date N.A.

Treatment date N.A.

Pre-treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	4	2	3
4-25-80	4	5	3
4-26-80	4	4	4

Pre-treatment Activity Index 4.3

Post treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	2	2	3
5-9-80	2	3	3
5-11-80	3	1	2

Post treatment Activity Index 3.0

RAW RESULTS FROM VISUAL CENSUS:

Field designation Larsen B

Plot Number 2

Treatment Control plot, no treatment

Pretreatment date N.A.

Treatment date N.A.

Pre-treatment Visual Observations:	Date	Obs. 1	Obs. 2	Obs. 3
	4-24-80	2	3	3
	4-25-80	2	1	1
	4-26-80	3	2	2

Pre-treatment Activity Index 2.7

Post treatment Visual Observations:	Date	Obs. 1	Obs. 2	Obs. 3
	5-8-80	3	3	3
	5-9-80	5	4	5
	5-11-80	5	6	5

Post treatment Activity Index 4.7

RAW RESULTS FROM VISUAL CENSUS:

Field designation Schavan

Plot Number 1

Treatment 2% Zinc phosphide, no prebait

Pretreatment date N.A.

Treatment date April 27, 1980

Pre-treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	4	3	3
4-25-80	4	5	2
4-26-80	4	5	4

Pre-treatment Activity Index 4.7

Post treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-1-80	5	6	3
5-2-80	2	2	3

Post treatment Activity Index 4.5

RAW RESULTS FROM VISUAL CENSUS:

Field designation Schavan

Plot Number 2

Treatment 2% Zinc phosphide, no prebait

Pretreatment date N.A.

Treatment date April 27, 1980

Pre-treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	1	0	0
4-25-80	1	1	1
4-26-80	5	1	1

Pre-treatment Activity Index 2.3

Post treatment
Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-1-80	1	1	1
5-2-80	2	2	1

Post treatment Activity Index 1.5

RAW RESULTS FROM VISUAL CENSUS:

Field designation Phelan

Plot Number 1

Treatment 2% Zinc phosphide, no prebait

Pretreatment date N.A.

Treatment date May 4, 1980

Pre-treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	7	7	10
4-25-80	8	9	13
4-26-80	11	7	6

Pre-treatment Activity Index 11.3

Post treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	2	1	0
5-9-80	0	1	2
5-11-80	2	1	2

Post treatment Activity Index 2.0

RAW RESULTS FROM VISUAL CENSUS:

Field designation Phelan

Plot Number 2

Treatment 2% Zinc phosphide, no prebait

Pretreatment date N.A.

Treatment date May 4, 1980

Pre-treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
4-24-80	3	6	5
4-25-80	7	7	8
4-26-80	5	5	10

Pre-treatment Activity Index 8.0

Post treatment Visual Observations:

Date	Obs. 1	Obs. 2	Obs. 3
5-8-80	2	3	1
5-9-80	1	3	3
5-11-80	1	2	1

Post treatment Activity Index 2.7